

Economic Evaluation of Transmission Interconnection In A Restructured Market

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Main Objectives for Transmission Expansion

- Connect large remote power plants to load centers
- Increase reliability of the transmission network
- Access to market hubs for surplus capacity/energy
- Take advantage of load diversity
- Increase resource and fuel diversity

Nature of Transmission Projects

- Capital intensive
- Very long lead-times for planning, permitting, final design, and construction
- Long economic and physical life
- Provide strategic value – resource access, reliability, insurance against contingencies

Transmission Project Benefits Analysis – Traditional Approach

- Multi-area production simulation model to estimate regional marginal costs (fuel plus variable O&M costs)
- Zonal transmission models, with aggregations of buses into zones and multiple circuits into single paths
- No feedback between transmission expansion and power plants construction
- Regional marginal costs as equal to regional prices (ignoring market power issue and the difference between marginal costs and bid prices)
- The benefit for each megawatt hour (MWh) of import based on marginal cost differential between importing and exporting regions
- Sensitivity analysis to evaluate uncertainties of fuel prices, load forecasts, hydro electricity production, and other factors

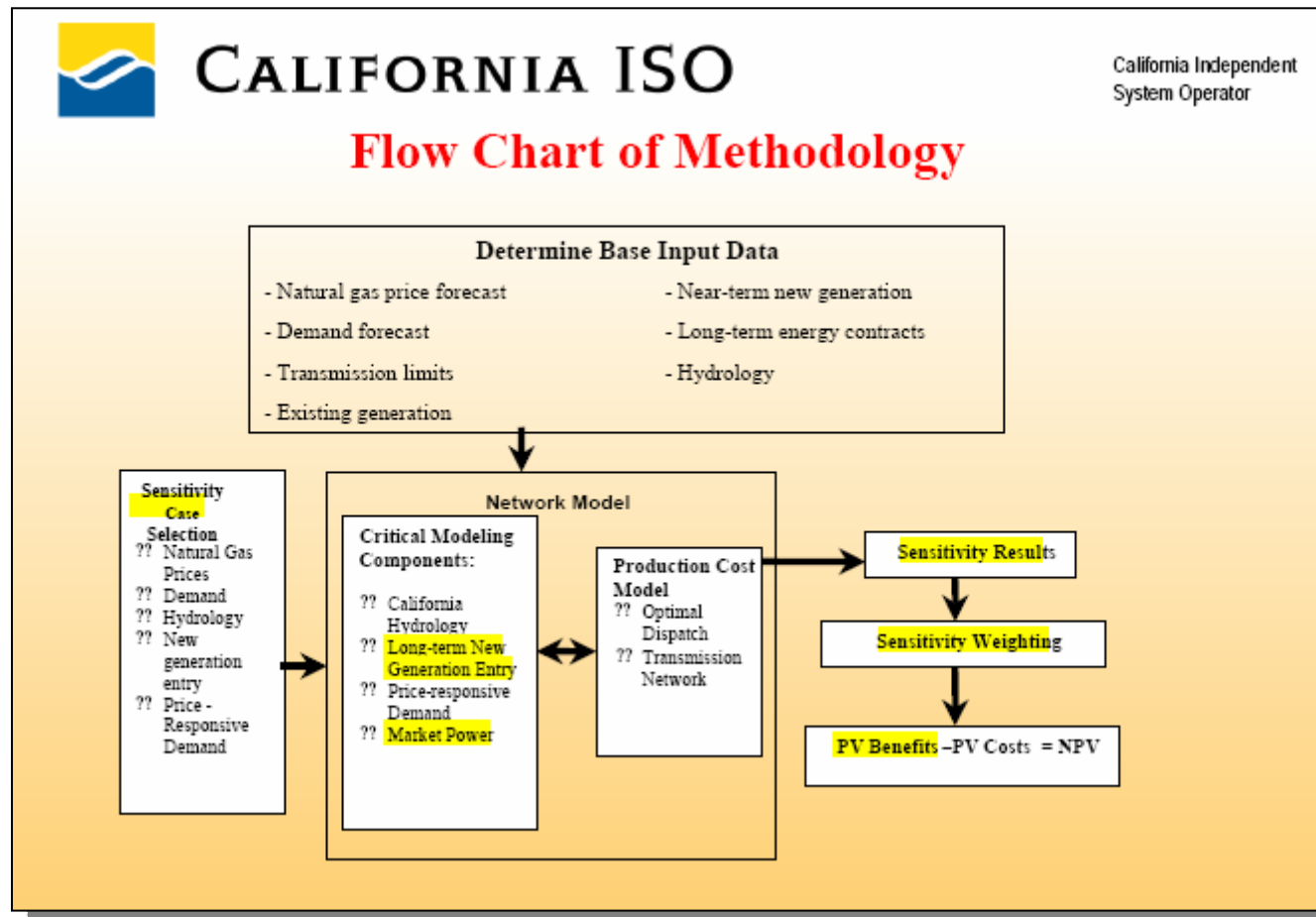
Factors To Be Considered In A Restructured Market

- Unbundled decision making for generation and transmission expansion
- The location of new generation creates congestion, since interconnection standards do not require “deliverability” to load centers
- Actual market prices are not the same as marginal production cost and bidding strategies of power suppliers have significant impact on power prices and their volatility
- Need more complex models to take into account bidding strategies (market power), the expansion and location of new merchant power plants, volatility and uncertainty factors, and accurate representation of the network system
- Changing regional power transfer patterns – unpredictable market behavior

CAISO Proposed Valuation Methodology

- Model market power and the development of regional prices based upon price-cost mark up method using historical data
- Develop robust set of scenarios to take into consideration insurance value of transmission in extreme cases and low probability events
- Select an appropriate production simulation tool (PLEXOS with a Microsoft Access software to manage its database)
- Represent transmission network using a DC optimal power flow model of the western grid
- Estimate benefits to customers, generation owners and transmission owners in multiple regions and rely on appropriate benefit-cost tests (participant test, societal test, and modified societal test)

CAISO Proposed Evaluation Methodology



Source: CAISO "TEAM" – Stakeholder Meeting 02/03/2004

CAISO's Economic Evaluation of Path 26

- Analysis is carried out for 2 years, 2008 and 2013
- Annual benefit is calculated for 2 years for
 - Customers
 - Producers
 - Transmission Owners
- Annual levelized cost is calculated based on cost for upgrades multiplied by a carrying charge
- Annual benefit is compared to levelized annual cost to see if the project is cost effective
- Models need extensive data, therefore, limiting analysis to only 2 years
- Long computer run times required for each year studied due to interaction of production simulation and full WECC DC optimal power flow network, which also limits the number of scenarios considered

Strategic Value of Transmission

- Price stability
- Decreased market power for the existing generators
- Potential for increased reserve sharing and firm capacity purchases
- Insurance against contingencies during abnormal system conditions
- Environmental benefits
- Reduction in construction of additional infrastructures
- Benefits accrue over a long time period – 30 to 50 years

Factors That Should Be Addressed in Future Updates to the CAISO Methodology

- At least five years of detailed analysis to capture the interaction between transmission and generation expansion and then extrapolation of results for the rest of the economic life of the project
- Consider potential for purchases of firm capacity from exporting regions to meet Resource Adequacy Requirements
- Environmental benefits by importing energy from regions outside of load centers where cost of air emissions are lower
- Reduction in construction of additional infrastructure such as gas pipelines as power imports reduces the consumption of gas in California for production of electricity

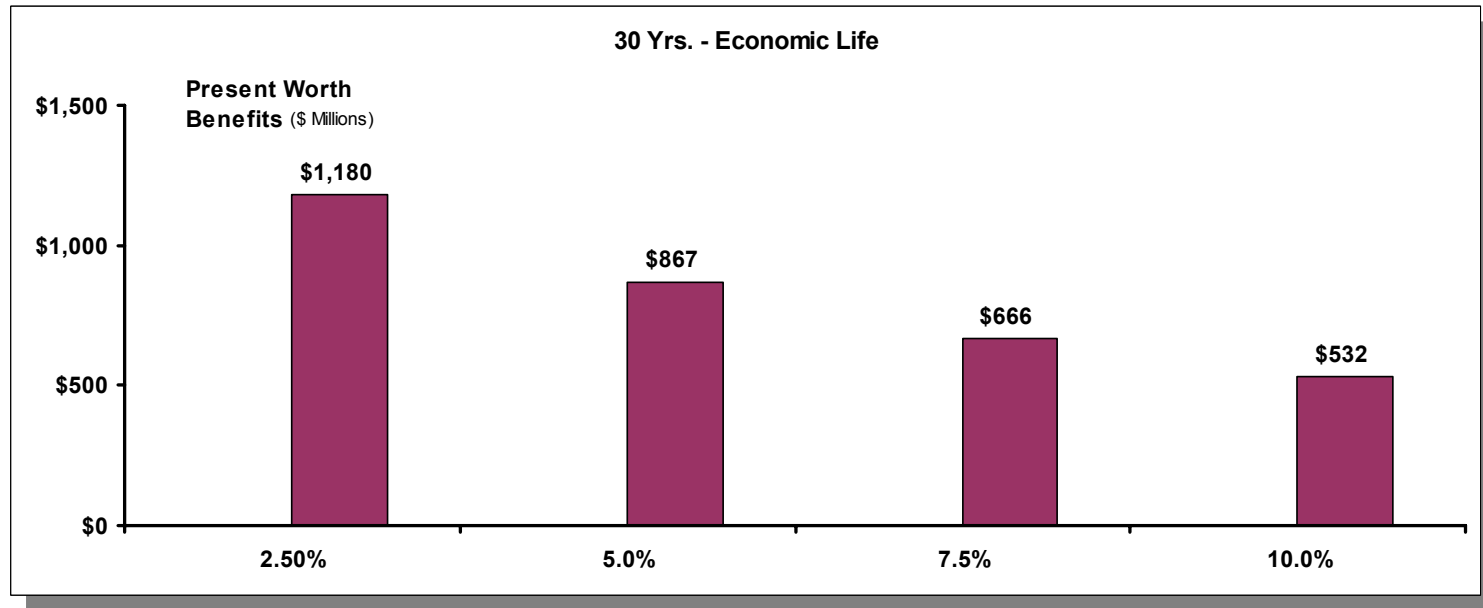
Valuation Methodology Needs To Recognize That Transmission Has Become a “Public Good” in a Restructured Market

- Transmission planning is shared among utilities, CAISO, and stakeholders
- CAISO controls operation of high voltage transmission lines
- The customers of the utility owning the transmission line do not receive all the benefits of the line
- The benefits from the expansion of the transmission network cannot be denied to any retail customer, nor to any generation and transmission owners regardless of who carries out the expansion
- The capital cost of the new high voltage transmission project is paid through Transmission Access Charge by all retail customers in the CAISO grid
- Costs of inadequate transmission resulting in congestion, market power, reliability problems are borne by the “public”

Utilization of A Social Discount Rate for “Public Good” Infrastructure Investments

- For calculating the present worth of a “public good” project social discount rate should be utilized
- Social discount rate is a function of per capita consumption growth rate, elasticity of the marginal utility of consumption and probability of survival of the “average consumer” from one period to the next
- Annual social discount rate for the U.S. is around 5%
- Using social discount rate of 5% versus cost of capital of 10% as a rate to discount the benefits over 30 years of economic life may increase the present worth of benefits by more than 50%
- Opportunity cost of capital should be used for determining the Transmission Access Charge

Impact of Discount Rate on Present Worth Benefits for 1,500 MW Transmission Expansion Project



Time Period	Line Loading *	Annual Energy Transmitted (MWh)	Avg. \$/MWh Price Differential (between import and export region)	Annual Benefit (\$000's)
On-Peak	80%	5,894,400	\$8.00	\$47,155
Off-Peak	40%	2,308,800	\$4.00	\$9,235
Annual Total		8,203,200		\$56,390

(*) Weighted avg. loading = 62%

Streamlining and Coordinating Planning and Permitting

- In planning phase the focus would be on:
 - Long term strategic issues
 - Building consensus on the need for transmission lines
 - Identifying potential projects
 - Corridor planning and right-of-ways acquisition
- In the permitting phase the focus would be on:
 - Specific projects needed in the next 5 to 10 year window
 - Economic justification using a detail valuation methodology
- The CAISO evaluation methodology is suitable for evaluating a specific project during the permitting phase

Acquisition of Right-of-Ways

- It has become very difficult to get siting approval for new transmission paths
- Regulatory steps should be taken to assure utilities are able to acquire needed right-of-ways and bank them so that the objectives of the long-term plans can be achieved and projects envisioned in these plans are constructed in a timely manner
- For economic justification of right-of-way acquisitions simple models must be utilized
- It should be sufficient to assess resource potential of different market hubs. Estimate the construction and the O&M costs of building power plants in each market hub. Establish the power cost differential among market hubs. Then, based on estimated line loading and power cost differential, calculate the benefit from construction of transmission lines between market hubs
- Based on estimated benefit and costs, request right-of-way acquisitions for cost effective lines

Recommendations

- ✓ Take into consideration the dynamic relation between transmission and generation expansion. Carry out analysis for at least 5 years to establish the feedback between a transmission line construction and new generation plant construction in the exporting region
- ✓ Capture the long-term benefits of transmission lines, at a minimum a 30 year economic life, by extrapolating the benefit analysis from the first five years or by estimating the cost of construction and operating power plants at exporting and importing regions and making reasonable assumption on loading of the new transmission lines
- ✓ Add to the analysis the value of the firm capacity created by construction of new transmission lines
- ✓ Include environmental benefits of the transmission expansion
- ✓ Use a Social Discount Rate to calculate the present worth of benefits